

# Nuts and Bolts – Design, Construction and Operation of LFGTE Projects

Mississippi LFG Energy Workshop  
S. EPA Landfill Methane Outreach Program  
April 25, 2002



# Regulatory Framework



# LFG Regulatory Framework

- RCRA Subtitle D
- NSPS
- Title V
- Other Clean Air Act Provisions
- State Rules
- Local Air District Rules



# Landfills Applicable under NSPS

- MSW Landfills
- Received Waste on or after 11/08/87
- Waste Design Capacity  $\geq 2.5$  million Mg
- Annual NMOC Emissions  $\geq 50$  Mg



# Title V Permits

- “Major Sources” require permit.
- Facilities subject to NSPS/EG require permit (despite being a minor source based on estimated emissions).
- Permit Components:
  - ❖ Emissions inventory
  - ❖ Review of applicable regulations
  - ❖ Application
  - ❖ Certification of compliance
  - ❖ Monitoring, reporting, and record keeping

# Design



# Landfill Gas Collection Systems

- Landfill gas extraction wells
  - ❖ Horizontal
  - ❖ Vertical
- Landfill gas blower stations
- Landfill gas condensate management
- Landfill gas safety issues



# Vertical Extraction Wells Design Criteria

## **Extraction Wells**

- Layout
- Spacing
- Borehole Depth
- Borehole Diameter
- Drilling Method
- Presence of Water
- Dual Extraction with Leachate
- Pipe Material
- Pipe Depth
- Well Screen
- Backfill





# Vertical Extraction Wells Design Criteria (cont.)

- Well Head / Lateral
  - ❖ Material
  - ❖ Above vs. Below Grade
  - ❖ Cover
  - ❖ Valve
  - ❖ Access for Monitoring



# Vertical Extraction Wells Design Criteria (cont.)

- Header Lines
  - ❖ General Layout
  - ❖ Depth
  - ❖ Material
  - ❖ Bedding / Backfill
  - ❖ Slope
  - ❖ Diameter
  - ❖ Protection



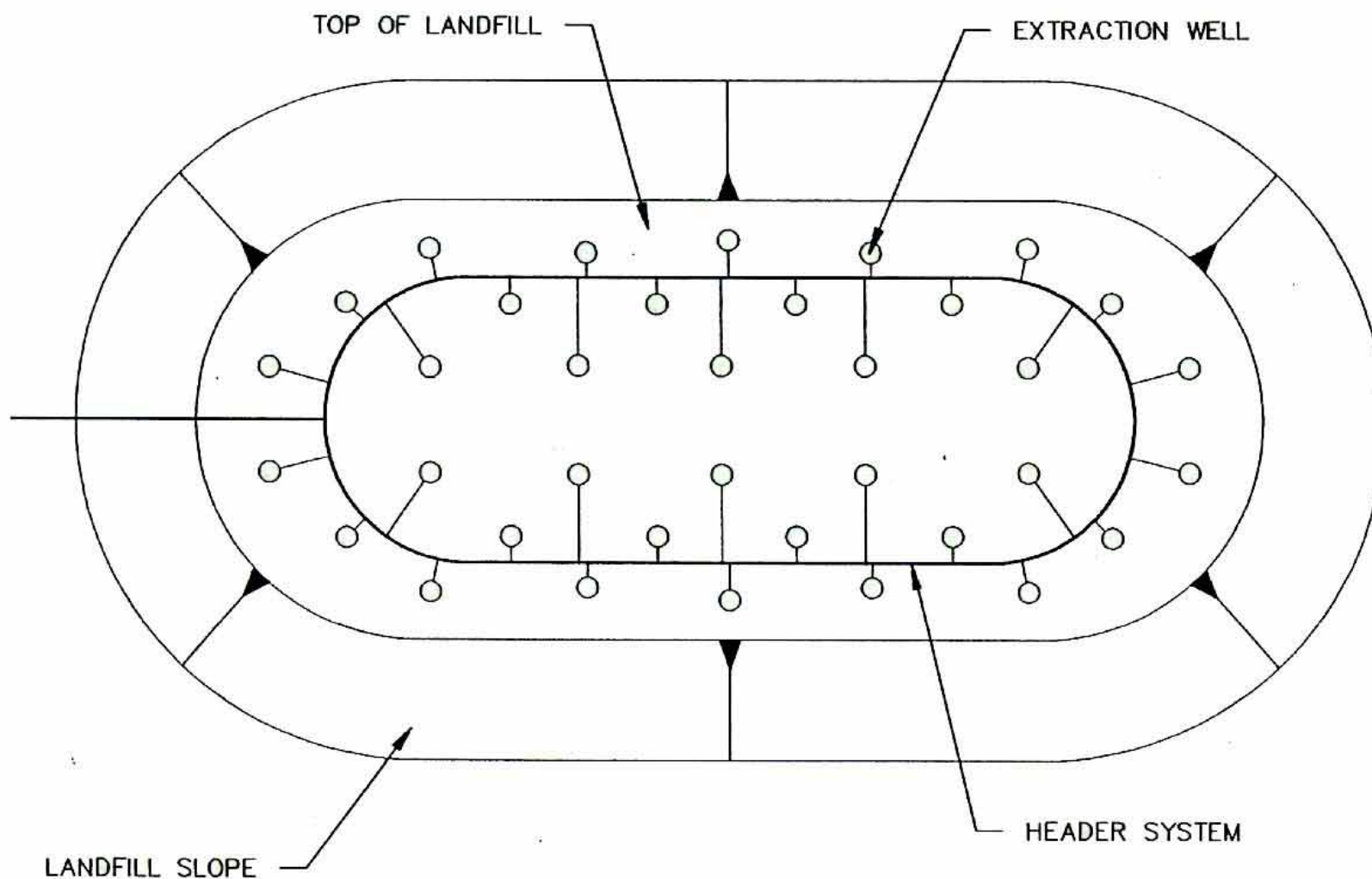
# Vertical Extraction Wells Design Criteria (cont.)

- Condensate Management
  - ❖ Vacuum Trap / Seal
  - ❖ Re-injection
  - ❖ Collection
  - ❖ Number / Location
  - ❖ Construction
  - ❖ Access
  - ❖ Maintenance



# Horizontal Collectors Design Criteria

- Layout
- Spacing
- Depth
- Material / Construction
- Bedding / Backfill
- Temporary / Sacrificial
- Permanent / final Cap
- Condensate Management



NOT TO SCALE

Exhibit 5-4. Single Loop System.

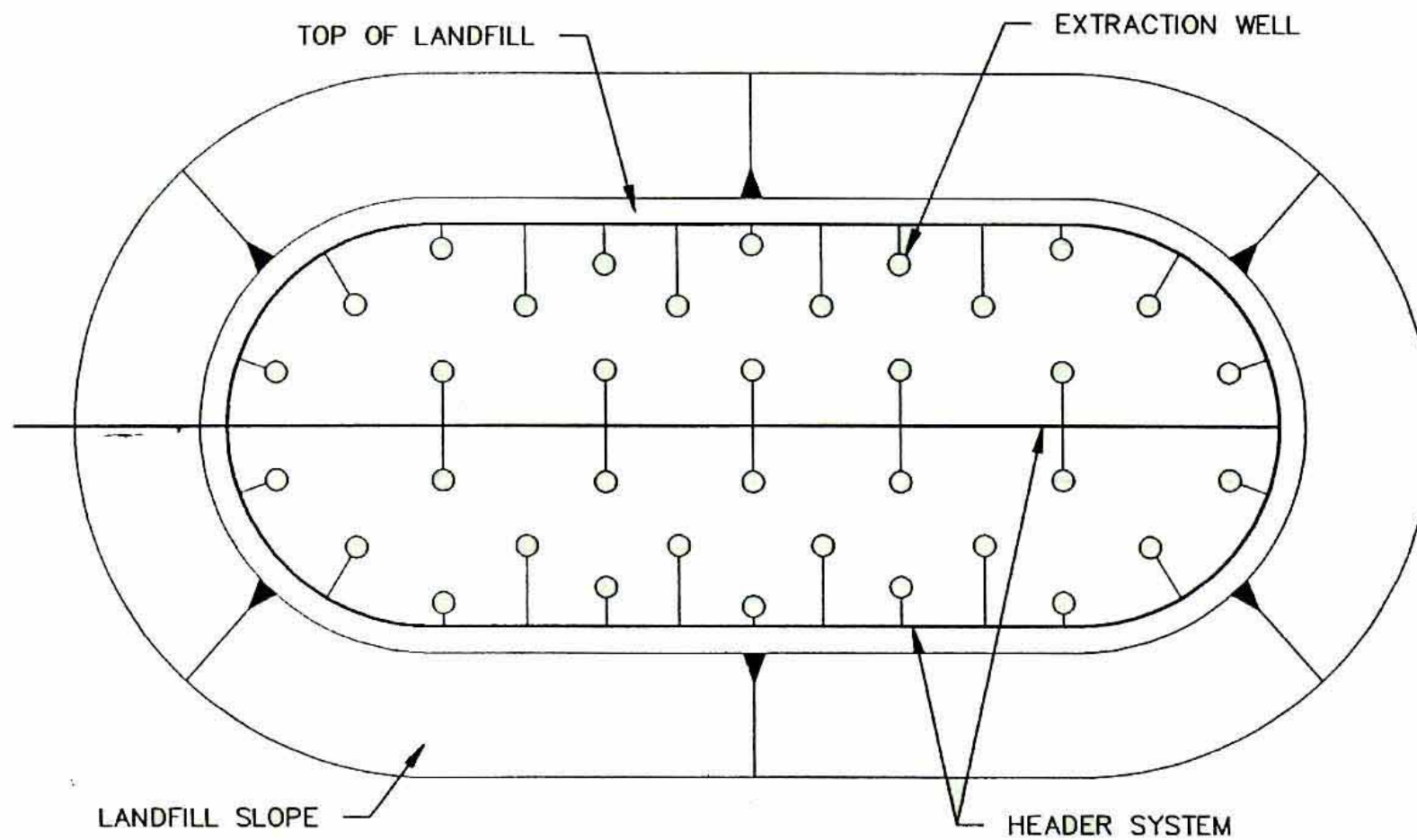


Exhibit 5-5. Dual Loop System.

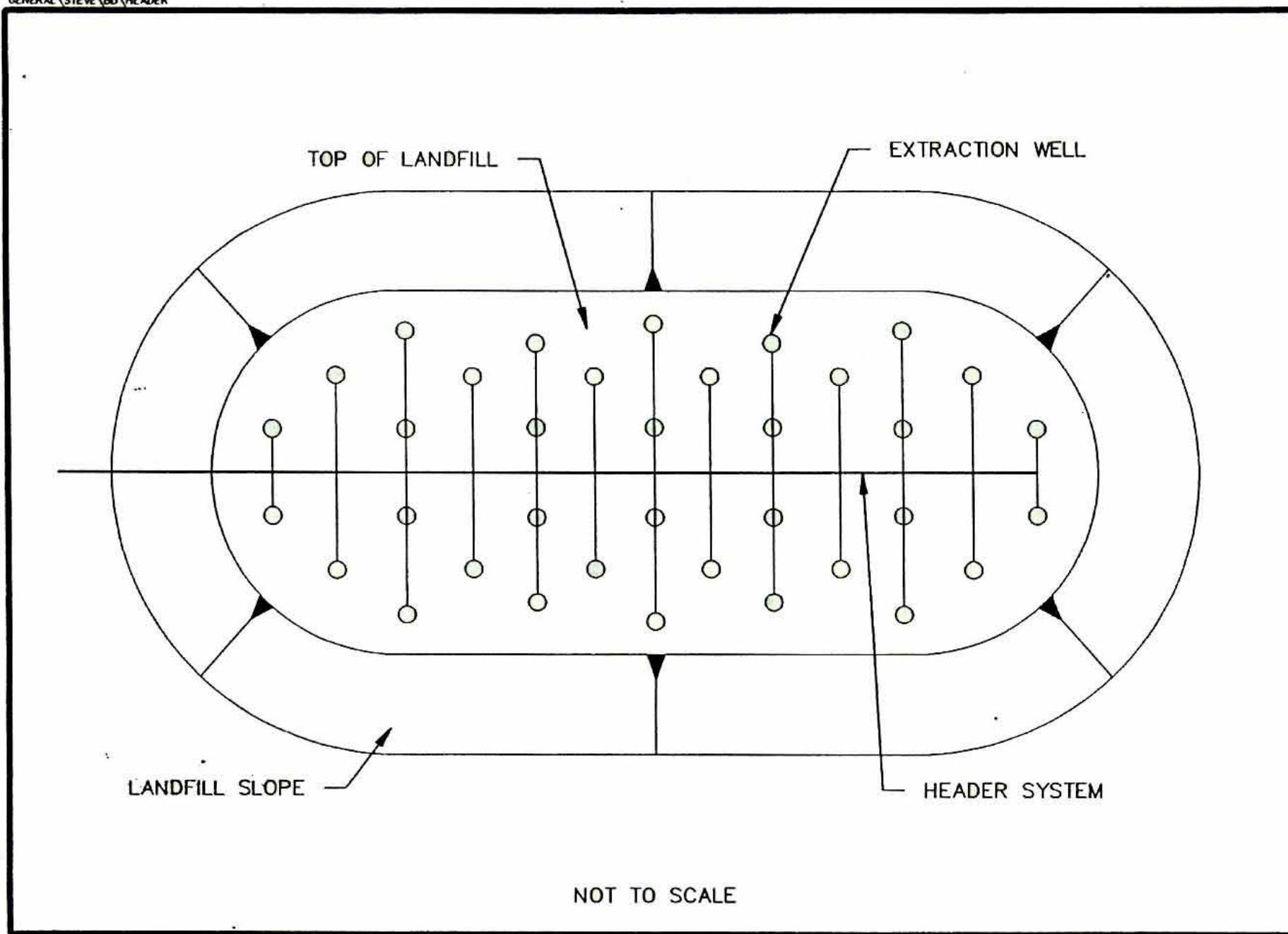
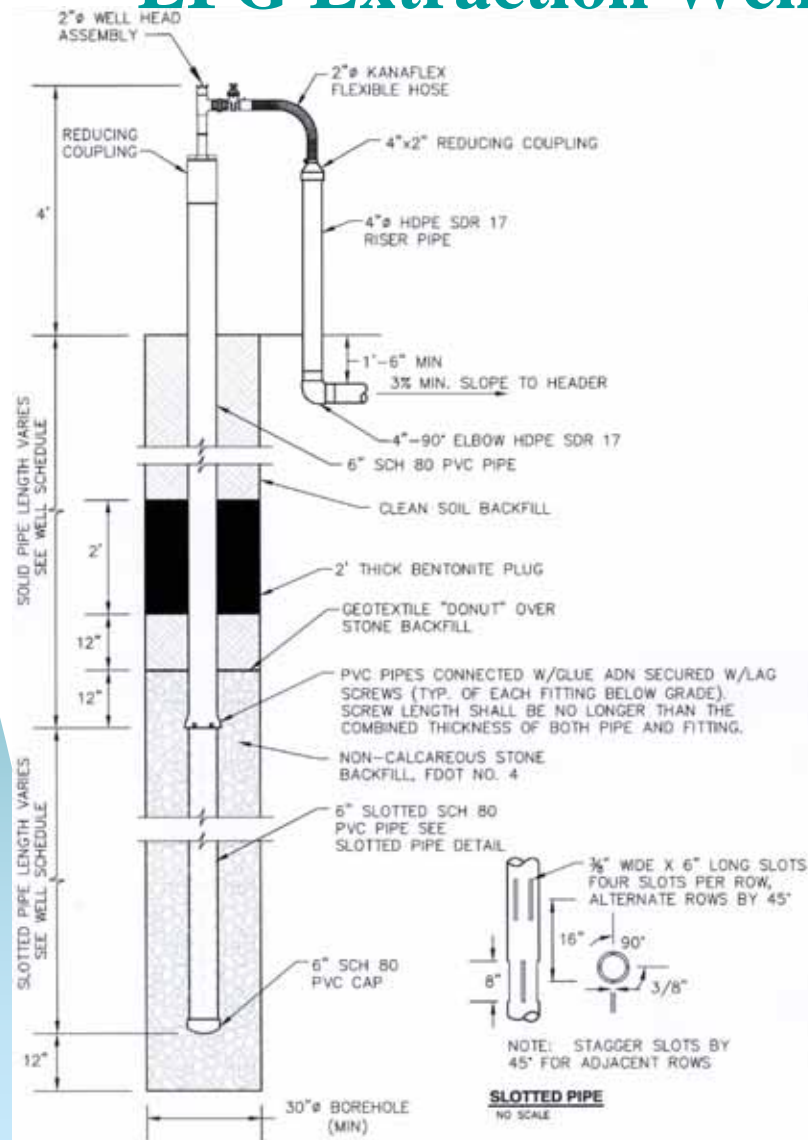


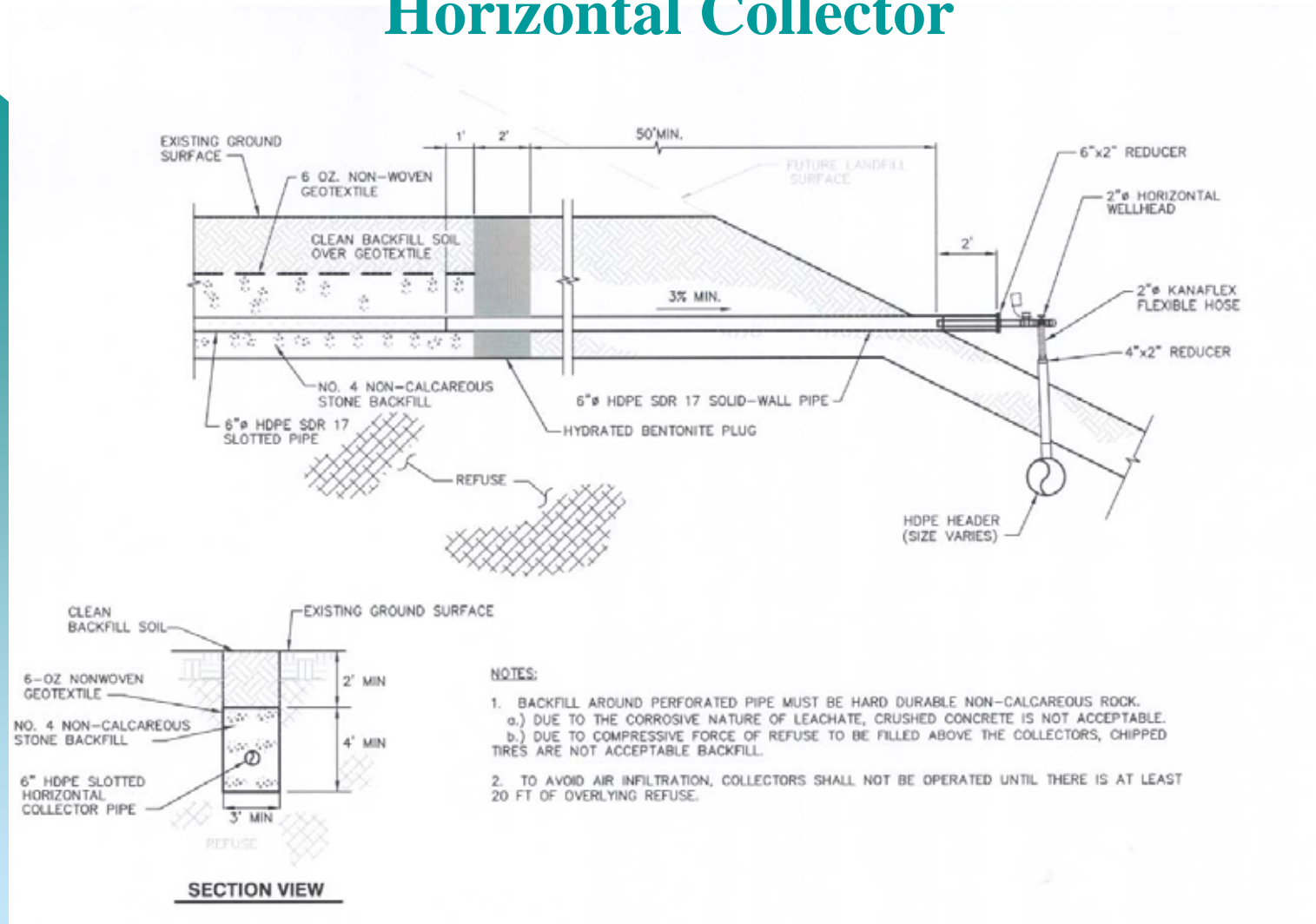
Exhibit 5-6. Single Header Line.

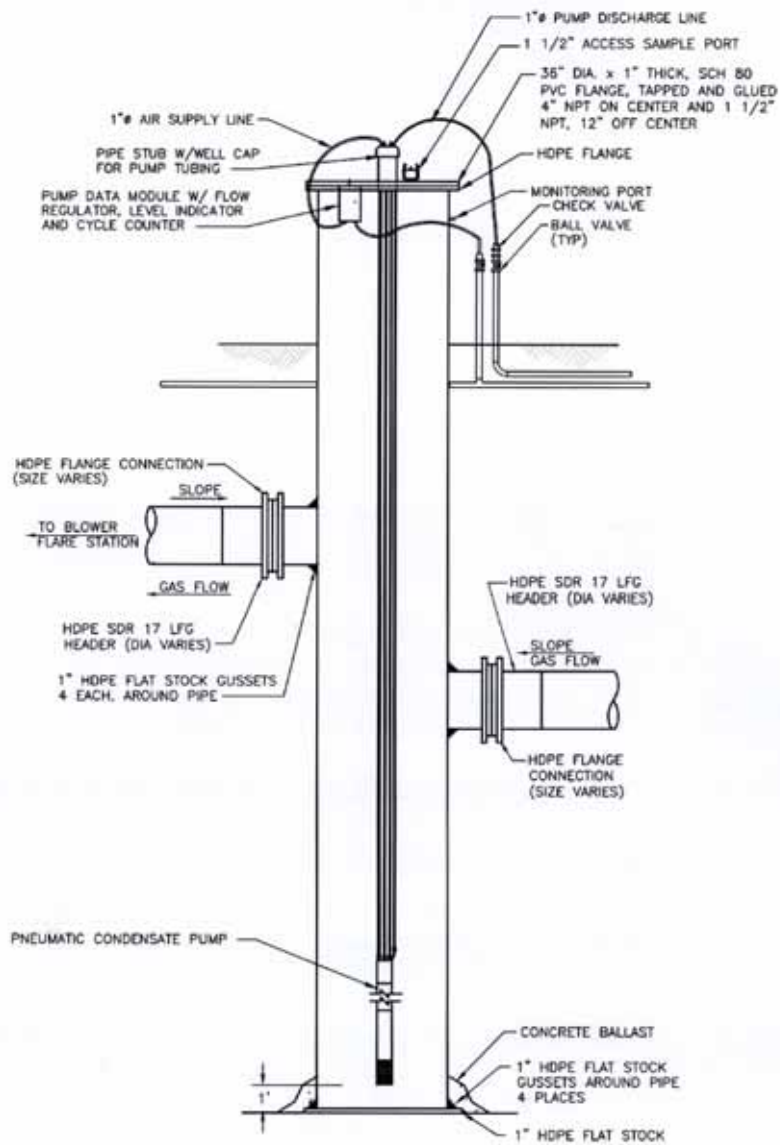
# LFG Extraction Well





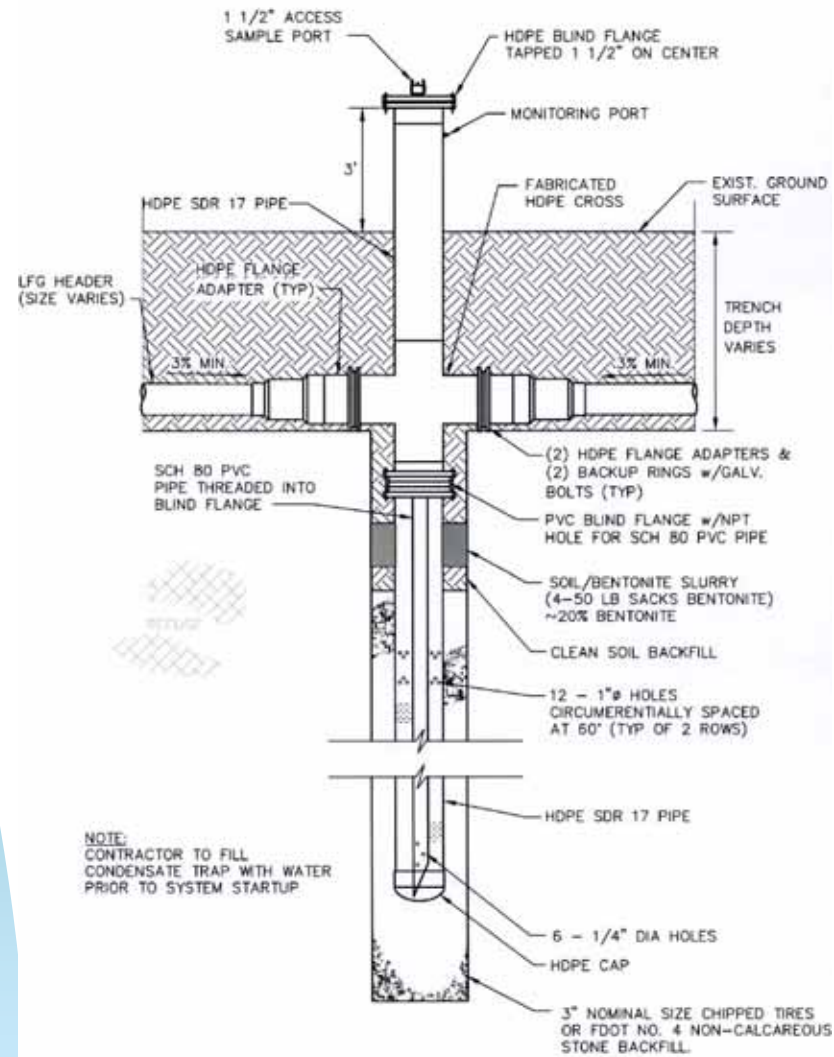
# Horizontal Collector



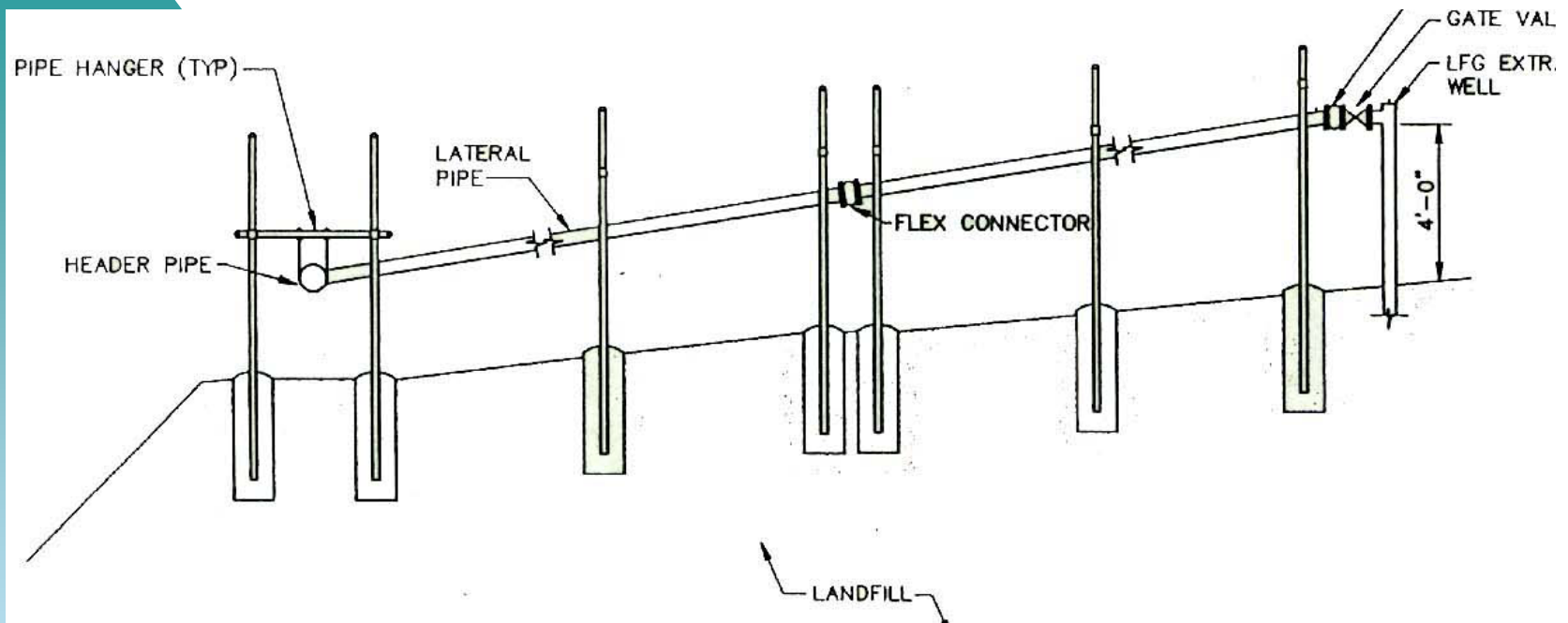


## Condensate Sump

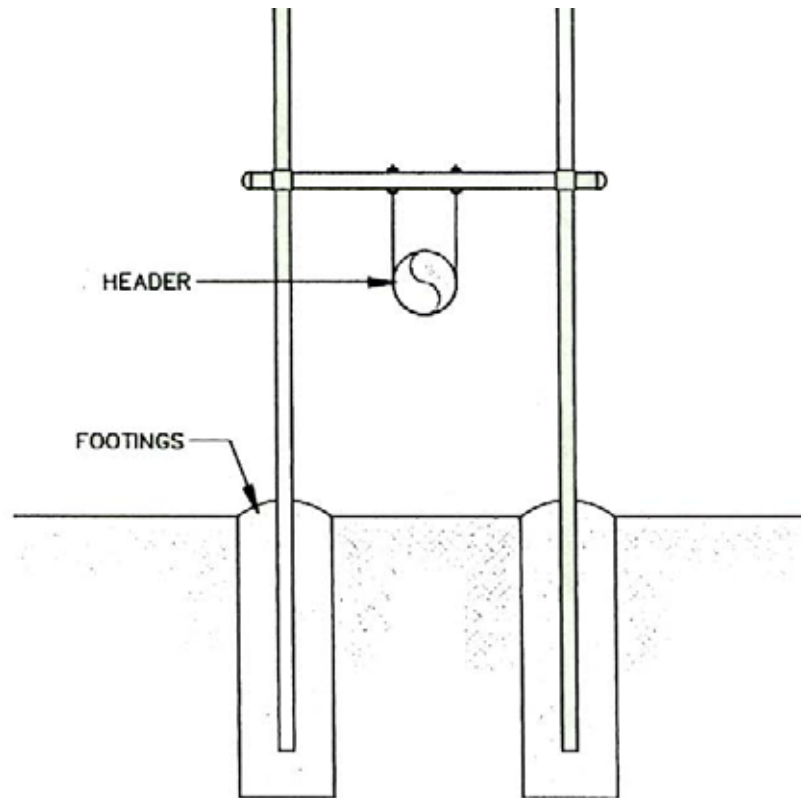
# Condensate Trap



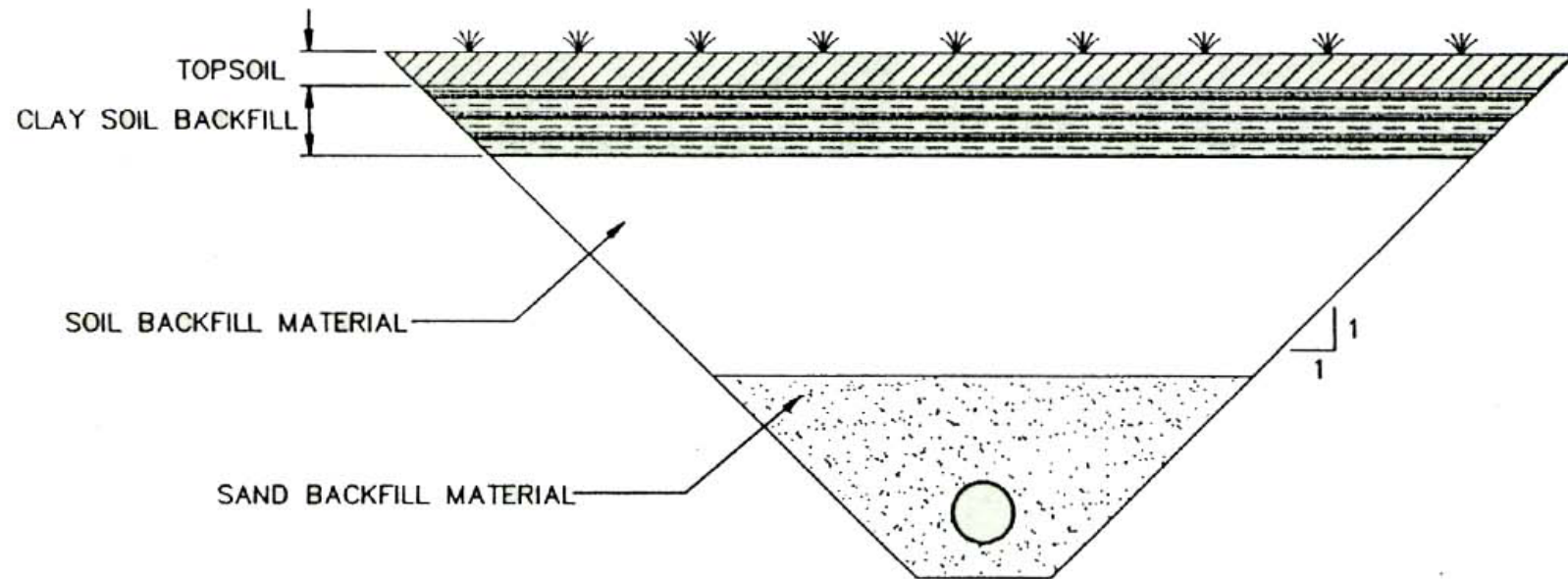
# Aboveground LFG Collection Pipes



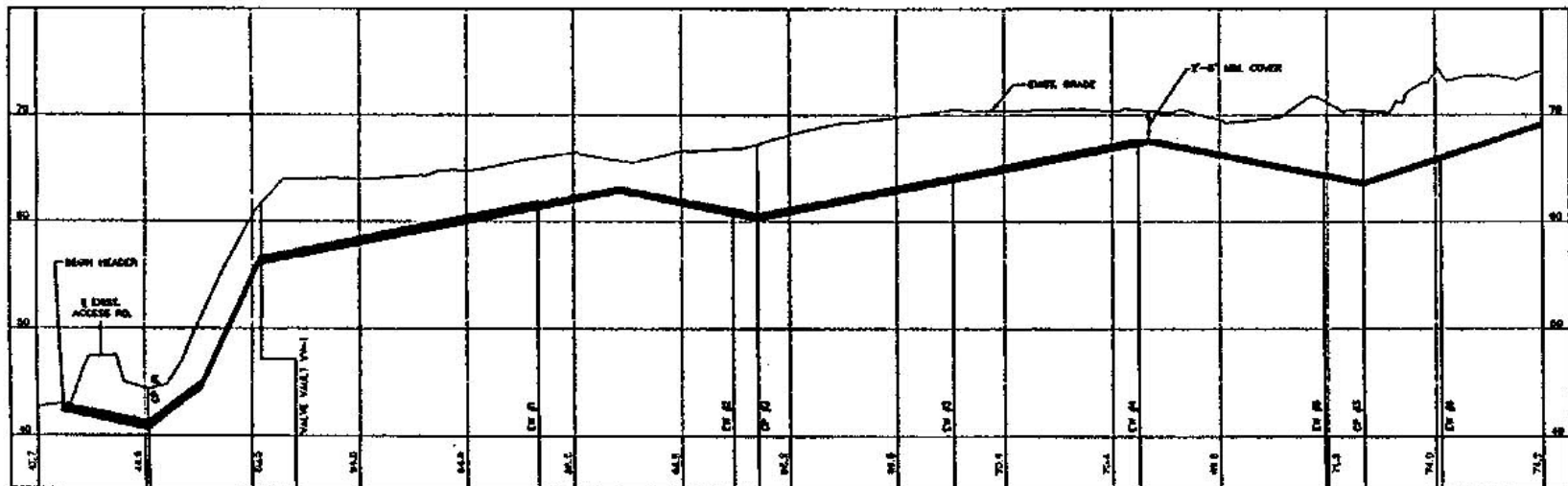
## Aboveground LFG Pipe Support Detail



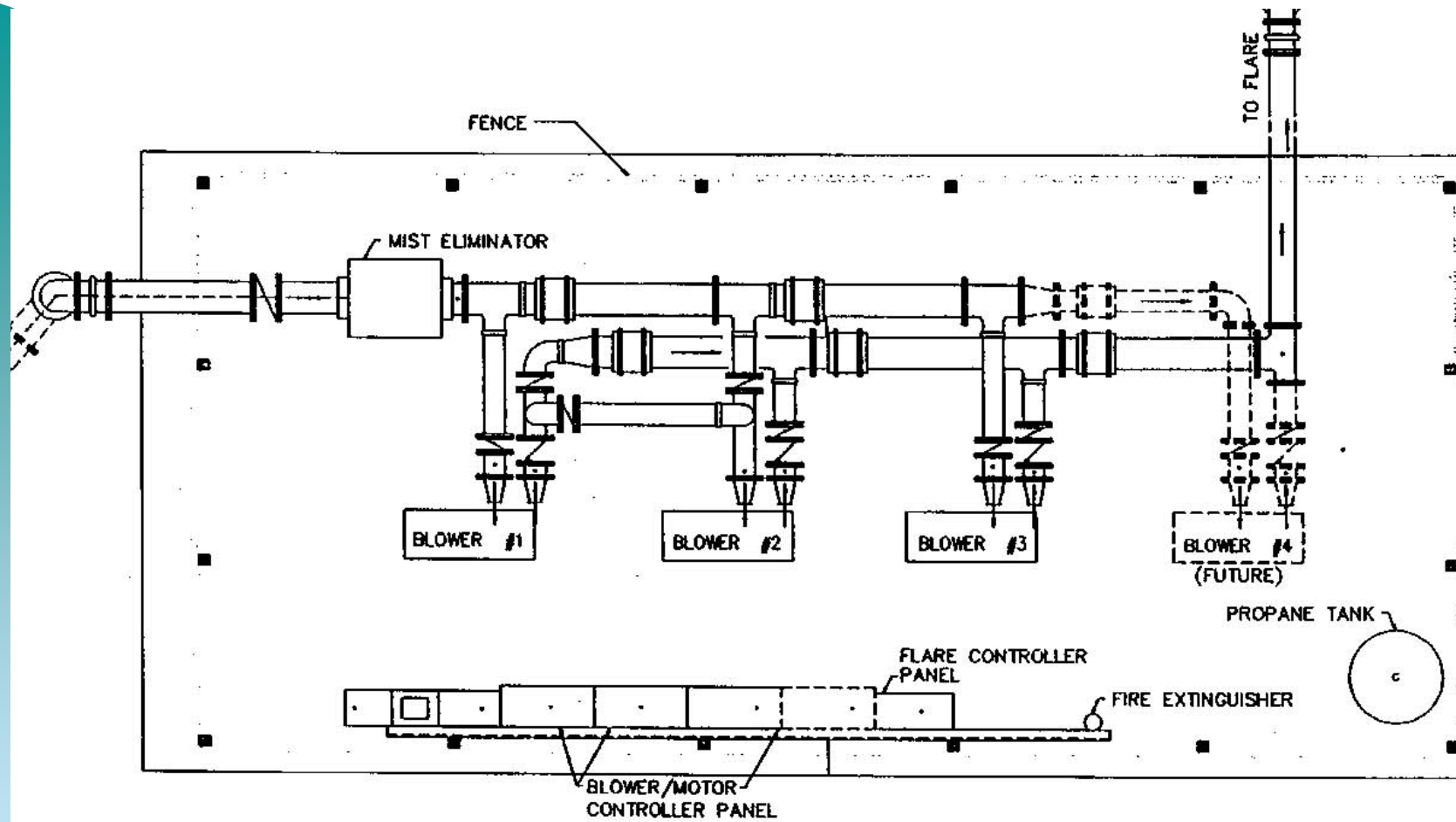
# Underground LFG Pipe Trench Detail



# LFG Header Profile



# Blower Station





# DISPOSAL AND UTILIZATION




# Other Blower /Flare Design Elements

- Secured Area
- Aboveground Piping
- Valving
- Condensate Management
- Monitoring System / Access



# Other Blower /Flare Design Elements (cont.)

- Security / Alarm / Control Systems
- Flame Arrestors
- Explosion Proofing
- Structure



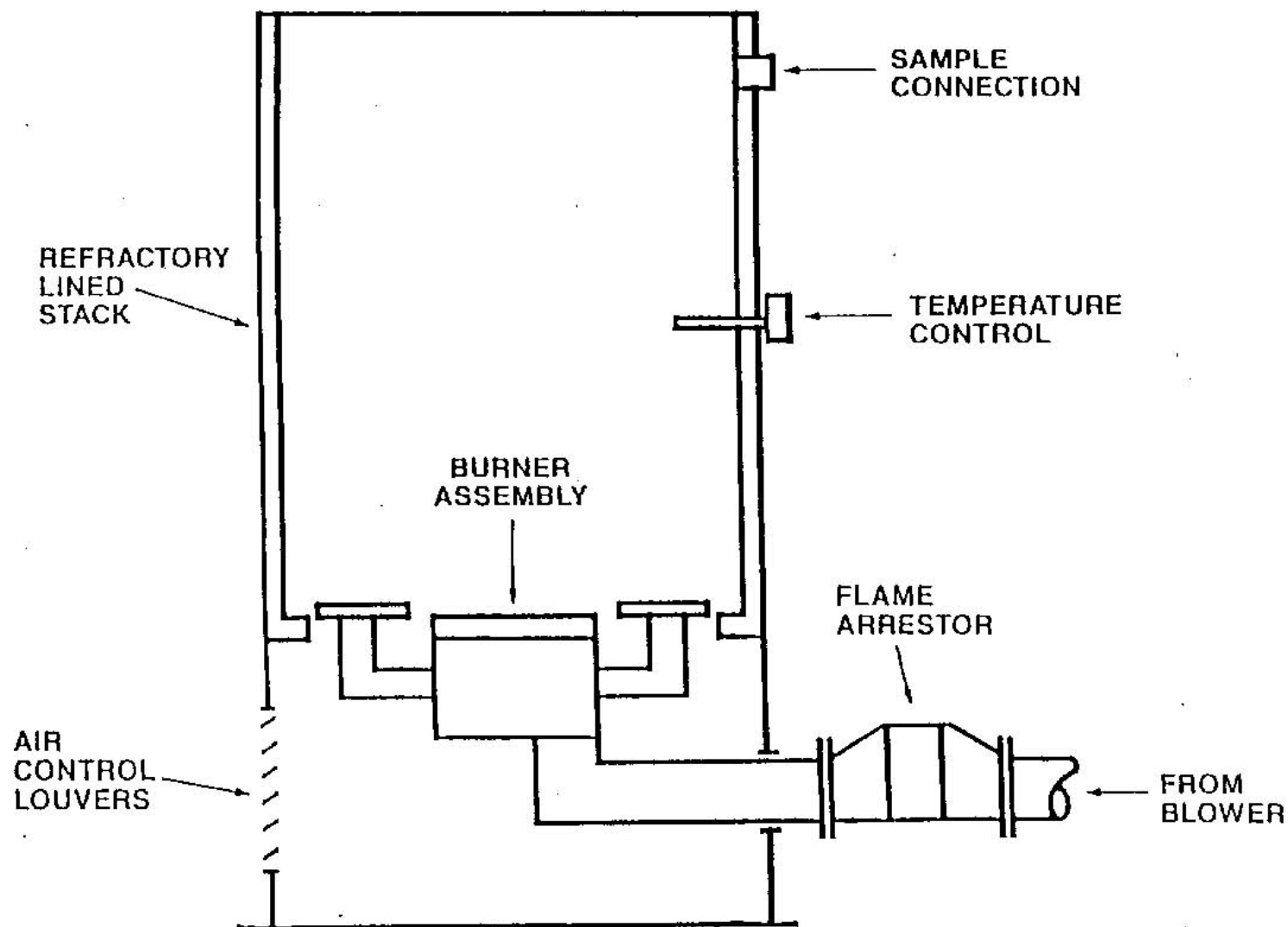
# LFG Blower Systems Design Elements

- Centrifugal Exhauster
- Explosion Proofed
- Condensate Management
- Electric Supply
- Electric Motor
- Number / Layout
- Material



# LFG Treatment / Disposal Design Alternatives

- Atmospheric Vent
- GAC (Carbon) Treatment
- Open / Candle Flare
- Enclosed / Ground Flare
- Incinerator
- End Use



NOT TO SCALE

SCS ENGINEERS

Exhibit 6-1. Flare.

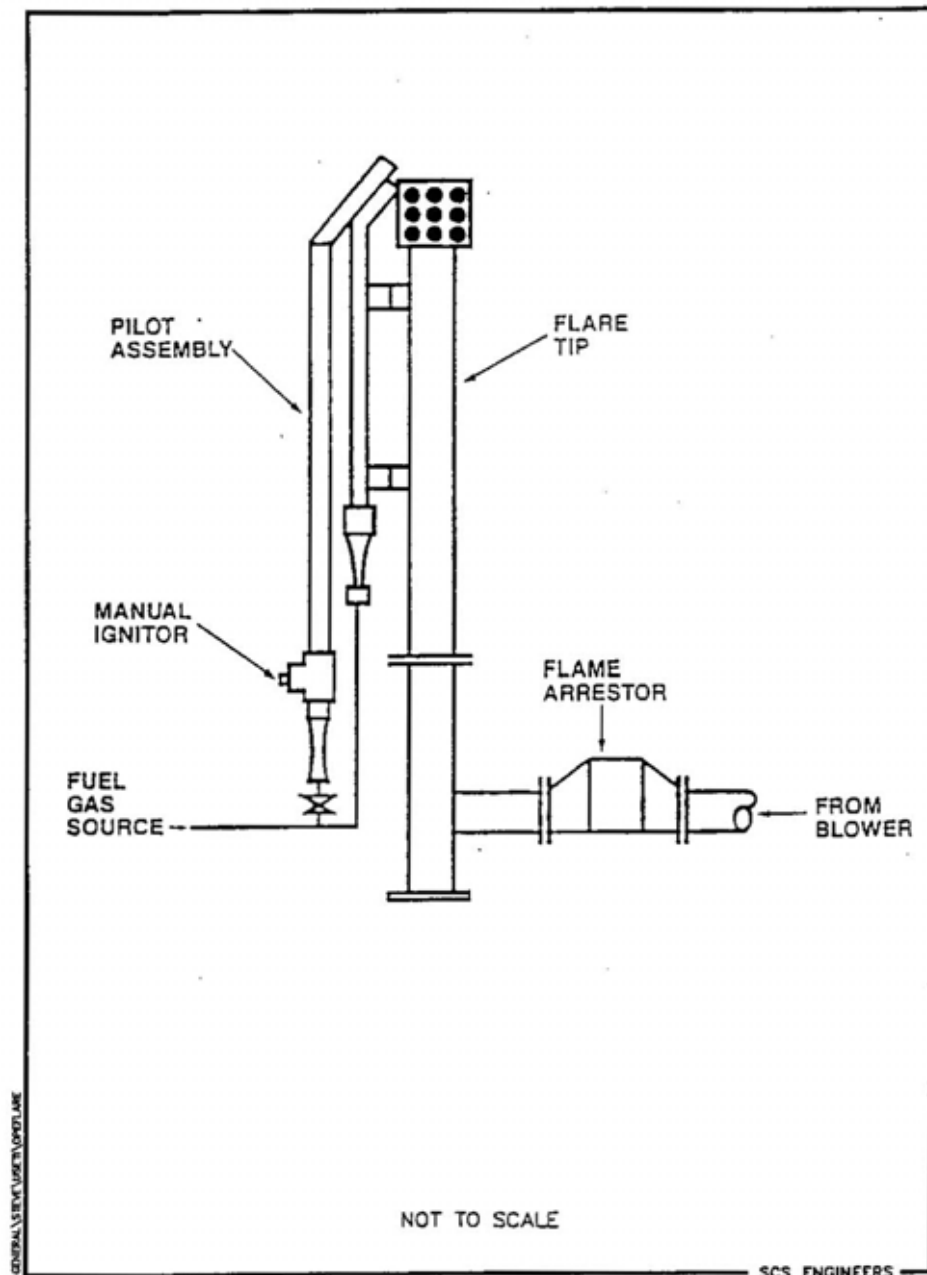


Exhibit 6-2. Flare



# Energy Recovery

- Electric generation
- Medium Btu
- High Btu
- Vehicle fuel
- Carbon dioxide recovery
- Fuel cells
- Chemical feedstocks



# CONSTRUCTION



**Boring activity for  
installation of LFG  
well**

**Perforated and solid  
piping for LFG wells**





**Installation of LFG  
header piping**

**LFG wellhead near  
completion**





**Completed LFG wellhead**

**Installation of LFG  
header piping**





**HDPE header pipe and  
condensate piping in trench**

**LFG lateral connection to  
header pipe**







**LFG header piping and  
isolation valves**

**Trench compaction and  
backfill**





**LFG header roadway  
crossings**

**Geosynthetic liner over  
trench**





**Condensate sump**

**Condensate sump with  
air regulator**







**Condensate sump**

**Candle flare**





**Flare and blower station**

**Dual flame arrestors**





**Construction of  
ground flare**

**Ground flare condensate  
knock-out and  
instrumentation**





**Typical blower shelter**

## Microturbine Facility





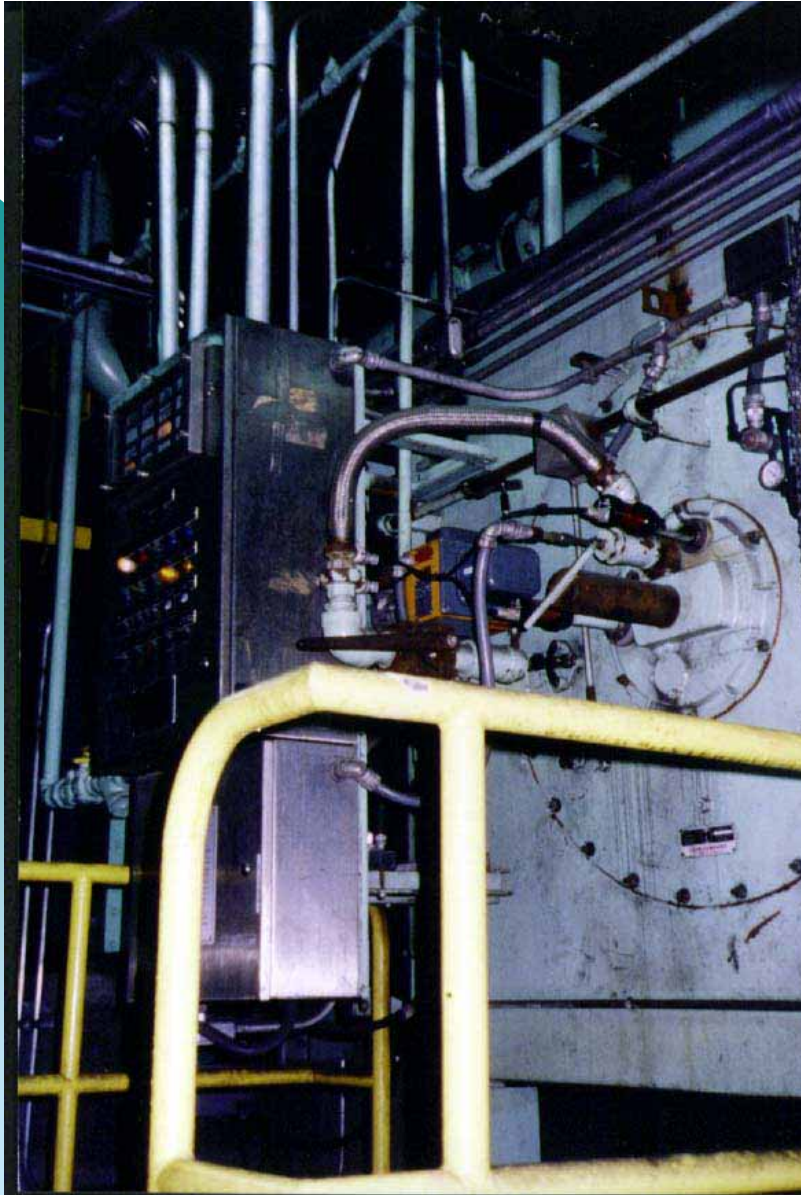


## Microturbine Facility

## Blower and Compressor Skid



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**Direct Use in a Boiler**

**SCS ENGINEERS**



## Reciprocating Engine Generators Using LFG

SCS ENGINEERS

# MONITORING, OPERATIONS, AND MAINTENANCE





# What to Expect

- Full-time or part-time personnel dependent on complexity of system.
- Coordination of the LFG developers monitoring needs with that of regulatory needs.
- Maintenance of wellfield
- Maintenance of energy recovery unit



# Surface Emission Monitoring

- Ensure Gas System Performance with Surface Emissions < 500 ppm CH<sub>4</sub>
- Use Portable CH<sub>4</sub> Device : OVA, FID, SEM
- Walk over LF Surface in Serpentine Fashion, Lines Spaced 30 m on Center
- Test 5 to 10 cm Above LF Surface
- U.S. EPA Method 21 as Modified
- Quarterly monitoring



# Title V Suggestions

- Carefully read draft permit.
- Make sure PTE allows for growth.
- See “big picture” - recognize potential secondary impacts to permit conditions.
- Evaluate all facility modifications w/r to impact on Title V permit.
- Take enforcement seriously.
- Budget for Title V annual fees.